

INTERNATIONAL CITY MANAGERS' ASSOCIATION  
1313 EAST 60TH STREET - CHICAGO 37, ILLINOIS

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## SHORT-RANGE ECONOMIC FORECASTING FOR CITIES

What kinds of economic and social data are available and where can they be secured, what techniques should be used in making forecasts, and how can a city best organize to handle the job of forecasting?

Short-range forecasts are essential to many phases of present-day municipal administration. Decisions regarding the expansion of utility services, thoroughfare planning, and the hiring of additional city workers frequently require an estimate of what is expected in the immediate future. These needs in turn are based on such facts and estimates as the population responsible for them, the taxable income or sales which permit their satisfaction, or the capital improvement costs which limit municipal action. Thus, the city official must anticipate developments in a number of fields--social, demographic, economic, and technological--before he can realistically or confidently approach the problems that confront him daily.

The basic question is one of use. How many drivers will use a proposed freeway in preference to existing thoroughfares? Will future growth of the city-owned light and power company justify added office space? Are more beds needed in the general hospital? Is juvenile delinquency increasing so fast as to warrant more police personnel? Should a new elementary school be built?

Fundamental to most of these representative problems is the factor of population. The number of electric light customers is now more closely related to increases in the number of households than to more subtle social, economic and technological characteristics and trends. School-room needs must be equated to the age composition of the population (which in turn varies with birth and death rates and in-and out-migration). General hospital bed standards are geared directly to total population. Highway construction is (or should be) both cause and effect of the spatial distribution of population.

Fiscal factors are likewise important. Whether a facility can be provided (no matter how badly needed) depends on whether it can be afforded. Consideration must be given to such matters as salary trends, building and materials costs, and tax revenues. If the city has a municipal payroll tax, the official will seek a forecast of personal incomes. If a substantial share of the city revenues comes from the state sales tax, the administrator will try to foresee the magnitude of retail sales. Municipal income from land and property taxes will necessitate insight into still other trends.

A number of suggestions which may help the municipal administrator in problems of the kind just outlined are listed below. Specifically, they concern data and data sources, techniques of forecasting, and how to organize for forecasting in five fields: population and housing, labor force and unemployment, incomes, expenditures, and price levels. Although other categories of data are often desirable, these five appear most relevant to the major problems confronting city governments.

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### Data and Sources

Accurate forecasting generally requires knowledge of recent trends. If possible, data should be on an annual, quarterly, or even monthly basis, and should cover at least a 10-year period. The more important types of trend information that are required and available for forecasting purposes are discussed here.

Population and Housing. It is often necessary to know the total population of a city, its spatial distribution, and the age and family composition of this population. Relevant housing data include the location of new units, the extent of doubling-up, vacancy ratios, and related information.

The total number of inhabitants must usually be estimated from indirect sources. Occasionally, the U. S. Bureau of the Census makes sample censuses of the larger metropolitan areas, as it did in June, 1944 and April, 1947.<sup>1</sup> Most cities, however, must estimate current population from records of residential construction, utility installations, births, deaths, and school enrollment. The number of new dwelling units can best be estimated, in many areas, from building, conversion and demolition permits. Among utility records the most reliable for estimating population are probably those on water meter installations. Birth and death data, indicative of "natural increase," are obtainable from state and local health departments.

Similar information can also be supplied by the National Office of Vital Statistics, which publishes an annual report called "Vital Statistics of the United States," but there is a considerable lag between the year of data and time of release. The amount of migration (a major factor in metropolitan population growth and decline) can be estimated from school enrollment trends, available from the local boards of education,<sup>2</sup> and from records of unemployment compensation offices.

Spatial distribution of the population within an urban area is even less likely to be found on a current basis in published form. The decennial federal census gives small-area data for a number of census-tract cities. Intervening years must be approximated from building permit data, land-use maps (often assembled by city planning commissions), aerial photographs, assessors' maps,

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<sup>1</sup>Summarized in A Chapter in Population Sampling (Washington: U. S. Bureau of the Census, N. D.) and Statistical Abstract of the United States: 1949 (Washington: U. S. Bureau of the Census, 1949), p. 54.

<sup>2</sup>See, for example, Henry S. Shryock, Jr., "Population Estimates in Post-censal Years," Annals of the American Academy of Political and Social Science, 188 (1936): 167-176, and "Methods of Estimating Postcensal Populations," American Journal of Public Health, 28 (1938): 1042-1047; Henry S. Shryock, Jr., and Norman Lawrence, "The Current Status of State and Local Population Estimates in the Census Bureau," Journal of the American Statistical Association, 44 (1949): 157-173; U. S. Bureau of the Census, "Illustrative Examples of Two Methods of Estimating the Current Population of Small areas," Current Population Reports, Series P-25, No. 20 (1949); and Robert C. Schmitt, "Estimating the Population of Small Cities," Proceedings of the Washington Institute of Government, 1950 (Seattle: University of Washington, in press).



and school enrollments.<sup>3</sup> Techniques for finding the local population pattern are detailed in a U. S. Department of Commerce release, "Population Analysis of Small Areas."<sup>4</sup>

The age composition of the population requires either a sample census or an estimate based on the most recent census, birth data, mortality tables and migration estimates. The 1944 and 1947 sample studies of the U. S. Bureau of the Census rather sketchily indicated age distributions. More often, it is necessary to apply the "cohort-survival" method to the five-year age groups listed by the federal census. This method is explained in the "United States Life and Actuarial Tables, 1939-1941," published by the United States Public Health Service.<sup>5</sup>

Family or household estimates can be made from studies of national trends, local sample censuses, utility installations, building permit records and similar sources. The decline in average household size, recently noted on a national level, can probably be assumed locally.<sup>6</sup> Bureau of the Census population studies usually investigate dwelling unit data as well.<sup>7</sup> Water meter installations and building permits are excellent indexes of trends in the number of households.

Labor Force and Unemployment. An excellent index of community economic health is the ratio of unemployed to total labor force. Such data are useful in estimating and anticipating the total welfare load, in industrial promotion efforts, and in estimates of income changes in the area.

The administrator can often resort to published reports dealing with localized data on this subject. State unemployment insurance data have been available for more than a decade, usually on a month-to-month basis for individual counties.<sup>8</sup> Reports of these state unemployment compensation agencies typically relate unemployment of covered workers to total covered employment. Relatively few persons in the labor force are not covered by such insurance at the present time. The decennial federal census gives great detail regarding the labor force, and the Bureau of the Census often includes questions on employment in its sample studies

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<sup>3</sup>See Norman Carls, How to Read Aerial Photographs for Census Work (Washington: U. S. Bureau of the Census, 1947), pp.24-29; Robert L. Wrigley, Jr., "The Sanborn Map as a Source of Land Use Information for City Planning," Land Economics, 25 (1949): 216-219; "Measurements of Construction Activity," Monthly Review, Twelfth Federal Reserve District; April, 1950, p.54.

<sup>4</sup>Business Information Service, May, 1950.

<sup>5</sup>By Thomas N. E. Greville. Washington, 1947, pp.22-23.

<sup>6</sup>U. S. Bureau of the Census, Current Population Reports, Series P-20, No. 31 (1950).

<sup>7</sup>See, for example, "Housing Characteristics of Metropolitan Districts: April, 1947," Current Population Reports, Series P-71, No. 35 (1947).

<sup>8</sup>The monthly Statistical Bulletin and Local Labor Market Developments: King County Area of the Washington State Employment Security Department are representative of this source. See also the Statistical Abstract of the United States: 1949, p. 256.



of large metropolitan areas.<sup>9</sup> Sometimes local groups are concerned with unemployment data; the Cincinnati school census, for example, has measured it annually since 1929.<sup>10</sup>

Income. Information on personal incomes is important both as an index of economic well-being and as an aid to estimating tax revenues in cities which have, for example, a municipal withholding tax.

Although family income data are scanty, total areal income and income per worker are available from a number of sources. Average wage and salary income per worker is given both by industry and county in most state unemployment compensation agency reports.<sup>11</sup> Federal income tax returns are likewise published on an areal basis. Some states and territories, such as Hawaii, have an across-the-board withholding tax which provides further data.<sup>12</sup> A more inclusive concept of income is "net effective buying income," roughly estimated for states, counties, and major cities each year by Sales Management magazine.<sup>13</sup>

Expenditures. Some sort of breakdown on expenditures is significant to municipal fiscal analysis. Retail spending is especially important, since state income taxes are intimately geared to the pattern of retail sales. Such taxes are normally refunded, in part, to cities or counties, and provide an important source of local revenue. Other types of expenditure affect city income from licenses, liquor taxes, and amusement taxes.

Published sources on retail sales and related data include the U. S. Census of Business, regular U. S. Department of Commerce releases for selected cities, Federal Reserve District reports, state studies,<sup>14</sup> Sales Management estimates, and scattered local Chamber of Commerce reports. The quinquennial Census of Business, last taken in 1949 (and covering 1948 data) is basic. The Department of Commerce surveys department store sales in certain cities and metropolitan areas, but usually expresses its findings only in index numbers.<sup>15</sup> Sales

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<sup>9</sup>See "Labor Force Characteristics of Metropolitan Districts: April, 1947," Current Population Reports, Series P-51, No. 35 (1947).

<sup>10</sup>"Unemployment in Cincinnati, 1929 to 1940," Handbook of Labor Statistics, 1941 Edition, Vol. I (Bulletin No. 694) (Washington: U. S. Bureau of Labor Statistics, 1942), pp. 208-210.

<sup>11</sup>See, for example, The Washington Labor Market, published monthly by the Washington State Employment Security Department.

<sup>12</sup>Summarized in Hawaii Facts and Figures, an annual publication of the Chamber of Commerce of Honolulu.

<sup>13</sup>Sales Management, May 10, 1950, pp.108-112.

<sup>14</sup>See, for example, Colorado Revenue News, issued monthly by the Colorado Department of Revenue, and the Annual Statistical Reports of the Tax Commission of the State of Washington.

<sup>15</sup>Illustrated by the Monthly Retail Trade Report, Independent Retail Stores, Pacific Region.



Management magazine publishes annual estimates for the 200 largest U. S. cities.<sup>16</sup> Private sources would seem to be the best bet for data in most local areas.

Price Levels. Price levels impose definite limits on municipal capital improvement programs. In addition, price levels have a bearing on whether a given city will accept the opportunity to remove rent controls, whether it should reassess real property, and many other decisions.

The chief source of price data is the Consumers' Price Index of the U. S. Bureau of Labor Statistics, reported on a monthly or quarterly basis for 34 large cities.<sup>17</sup> The index is a percentage of the 1935-39 average for each area, and breaks down into separate indexes for food, clothing, rent, food-electricity-ice, house furnishings and miscellaneous. It gives the "average changes in retail prices of selected goods, rent, and services, weighted by quantities bought by families of wage earners and moderate-income workers in large cities in 1934-36."<sup>18</sup> Data for the nearest city for which data are published can be adapted for use in smaller municipalities.

Similar price indexes are available for many specific items. The "Survey of Current Business," a monthly publication of the Department of Commerce, regularly lists series on a great number of commodities, both wholesale and retail, on a national level.<sup>19</sup> These indexes can often be applied to a local purchasing problem.

Other Information. For other types of information the administrator often has recourse to the annual reports of utility companies or city departments, to special studies made by the local chamber of commerce or council of social agencies, to analyses of the state university or a nearby college (many have bureaus of business, governmental or population research), and to a great wealth of unpublished federal census material.<sup>20</sup> Needs will vary, of course, from city to city, as will resources of data.

### Projection Techniques

Once the above trend data have been assembled, it becomes possible to apply one or more statistical techniques to arrive at a short-term forecast. Three basic methods are typically used: extrapolation, correlation, and some form of "analytic" technique. Often two or more of these methods are combined in a single forecast.

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<sup>16</sup>The most recent series listed total retail sales, food store sales, general merchandise sales, drug store sales, and furniture-household-radio sales (Sales Management, May 10, 1950, pp.114-122).

<sup>17</sup>See the Monthly Labor Review of the U. S. Bureau of Labor Statistics, Tables D-2 and D-3 in each issue.

<sup>18</sup>Statistical Abstract of the United States: 1946, p. 290. A similar index, covering 60 individual cities, has been developed by the National Industrial Conference Board (see the Statistical Abstract of the United States: 1949, p.310).

<sup>19</sup>Summarized in Section 12 of the Statistical Abstract of the United States: 1949, pp.298-316.

<sup>20</sup>The U. S. Bureau of the Census will often make special compilations of unpublished data, at cost.



Extrapolation. Extrapolation is the extension of a trend line beyond its last plotted point. First, it is necessary to plot (either graphically or in tabular form) the month-to-month or year-to-year trend in population, income tax payments, or whatever type of data is under analysis. This trend is generalized and projected as far as desired into the future.

The projection may be achieved by any one of several acceptable methods. The easiest way is by inspection, either freehand or aided by a French curve. More objective is the mathematically fitted curve. Examples of this method are "least squares" and logistic curves.<sup>21</sup>

Extrapolation has frequently been used in the past. On a national and worldwide scale, Raymond Pearl has applied the logistic curve to population data.<sup>22</sup> Many of the early city planning studies depended on "least squares" projections of demographic data. Their occasional successes and frequent failures have been reviewed in such works as the International City Managers' Association's "Local Planning Administration"<sup>23</sup> and the American Society of Planning Officials' report called "Population Forecasting."<sup>24</sup>

Extrapolation has acquired a bad odor in recent years. It is a mathematical technique which blindly assumes that things will happen just as they have in the past. Perhaps its only virtue is simplicity of application.

Correlation. Correlation is the degree in which changes in one variable are associated with changes in another. It is measured statistically by rather complex formulas (best of which is the Pearsonian coefficient of correlation), but a fair idea of the degree of correlation in a given instance can be gotten from a scatter diagram.<sup>25</sup>

There are good reasons for the use of correlational technique in municipal forecasting. Some trends are easier to project than others, or are more likely to have been analyzed. National trends, for example, are more accurately projected than local trends because of the inherent stability of larger populations. Furthermore, forecasts at the national level are more commonly encountered in the published literature than purely local studies and forecasts. The correlation technique enables the locality to take advantage of these available forecasts on a national or regional level, usually made at greater expense than a city can afford.

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<sup>21</sup>Extrapolation is described in statistics texts. See, for instance, Frederick E. Croxton and Dudley J. Crowden, Applied General Statistics (New York: Prentice-Hall, Inc., 1940), Chapters XIV-XVI.

<sup>22</sup>See The Biology of Population Growth (New York: Alfred A. Knopf, 1925).

<sup>23</sup>Chicago, 1948 (2d ed.), pp.69-73.

<sup>24</sup>Planning Advisory Service, Information Report No. 17 (Chicago: August, 1950), pp.19-22.

<sup>25</sup>See, for example, Croxton and Crowden, op. cit., Chapters XXII-XXV.



This technique is illustrated by a 1947 study of the population of Flint, Michigan.<sup>26</sup> A very close correlation was found between Flint manufacturing employment and national durable goods employment during the 13-year period, 1928 through 1940. A national forecast for 1950, published by the Bureau of Labor Statistics,<sup>27</sup> was inserted in the formula describing this relationship. The equation, solved for Flint, gave an excellent estimate of local 1950 manufacturing employment. The latter was expanded by assumptions regarding size and composition of labor force to an estimate of total population. (The metropolitan area "medium" forecast by this method was 275,000, as compared to the actual 1950 census count of 270,034. In 1940 the population was 227,944).

"Analytic" Techniques. Still another method is building up a projection from the application of reasonable assumptions to each phase of a larger problem. Population growth, for example, can be broken down into three components and each analyzed separately. Natural increase might be based on a national study recently made by P. K. Whelpton;<sup>28</sup> annexation, on petitions currently in circulation; and net migration on a typical period in the past.

Combinations. Most short-range forecasts utilize several of the methods outlined above. The ratio system, for instance, involves computing the ratio of local income (or labor force, or retail sales) to the corresponding national figure. The ratio is then generalized, extrapolated, and applied to a national forecast that is already published.<sup>29</sup> Projections of local income may assume the 2 1/2 per cent yearly increase in productivity per U. S. worker estimated for the past half-century (an "analytic" technique) and apply it to current income estimates derived from correlations with recent rental data. Similar combinations of the three basic methodologies are to be found in the economic base reports of major city planning commissions.<sup>30</sup>

It should be noted, however, that future projections can indicate at best only a reasonable range of possibility. It is at least of equal service to the area to make a clear statement of what factors peculiar to the local economy need attention if the indicated potentialities of the area are to be achieved more fully than not. The basis for such a statement should arise largely from a penetrating

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<sup>26</sup>The Future Population of Metropolitan Flint (Ann Arbor: Institute for Human Adjustment, Horace H. Rackham School of Graduate Studies, University of Michigan, July, 1947).

<sup>27</sup>Monthly Labor Review, March, 1947.

<sup>28</sup>Forecasts of the Population of the United States: 1945-1975 (Washington: U. S. Bureau of the Census, 1947).

<sup>29</sup>Described in Local Planning Administration, p. 70 (method 3).

<sup>30</sup>Examples are The Economic Status of the New York Metropolitan Region in 1944 (New York: Regional Plan Association, Inc., 1944), Forecasting a City's Future, Sacramento, California (Sacramento: California State Reconstruction and Reemployment Commission, 1946), and The Economy of the Cincinnati Metropolitan Area (Cincinnati: City Planning Commission, December, 1946).



over-all economic study regarding the problems and opportunities of the major phases of the community's economy.<sup>31</sup>

### Organization for Forecasting

Adequate organization for forecasting has been a major stumbling block to the municipal administrator, but need not be. The mechanics of locating and assembling data can be appreciably simplified if a proper routine of collection, tabulation and recording is set up. Because of the need for inter-agency cooperation, a representative committee to support and direct a research program may be desirable. The complexity of many projective techniques makes the assignment of a qualified statistician, preferably from the city payroll, to the program highly desirable. Unless such steps are taken, the administrator may find it extremely difficult to obtain the current data and forecasts summarized above. The following steps not only should assure good results but are within the resources of even small cities.

Setting Up a Research Committee. The city manager or mayor might well appoint a research committee to help a research program of this kind. Every city has persons who handle pertinent socio-economic data regularly as part of their jobs. Such workers include employees of the local unemployment compensation office, the chamber of commerce, the real estate board, market researchers for department stores and newspapers, utility executives, social workers, public health personnel, teachers in the social sciences, and others. Their membership on a city research committee would assure cooperation by the agencies they represent (which would be asked to supply most of the needed information), encourage citizen participation in the program, and generally improve public relations. A member of some city department--say, the research man for the planning commission--would be a good choice for secretary of the committee.

Setting Up a Routine for Collection. The research committee must decide at the outset what information is desired, where it can be found, and how it can be recorded and tabulated.

Rather than attack the problem of municipal forecasting piecemeal, the committee would do well to decide at the outset what is needed, then begin all statistical series simultaneously. Thus, although it may be content for the moment with a limited amount of data (a simple series on retail sales, for example), the committee should realize that it may eventually want records on population, income, and labor force trends. It should anticipate these wants, and begin collecting all kinds at once. Thus, its series will have identical base periods (especially valuable if data are expressed as index numbers), and it will be able to set up the research program with a minimum of duplication and repetition of effort.

The work of collection and tabulation should be routinized. Building permits should be spotted the day they are awarded, unemployment reports should

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<sup>31</sup>See Victor Roterus, "The Economic Background for Urban Planning," Planning 1946, (Chicago: American Society of Planning Officials, 1313 E. 60th Street); and "The Geographic Bases of Urban Planning," Business Information Service (Washington: U. S. Department of Commerce, June 1950). Other sources cited in Victor Roterus and Max R. Bloom, "Community Development," Business Information Service (Washington: U. S. Department of Commerce, April 1949).



be labeled and filed as soon as received, tax returns should be reported as soon as the tax period is over. If precautions of this sort are not taken, data tend to be lost, the work of tabulation piles up, and current estimates lose their freshness and value.

To simplify the work, the committee should carefully consider the possibilities of coding data for punch-card use. Studies so aided will gain in accuracy and time-saving. Dual use of data should be recognized. Building permits can be used for both population analysis and keeping land use maps up-to-date. Data on retail sales will be found desirable by both government and business groups.

Appointing a City Analyst. In the last analysis, however, work of this complexity requires the services of a regular research specialist. Training in both statistical methods and the social sciences (such as economics, economic geography, sociology, etc.) is essential. Many larger cities already employ workers of this general background--some in the budget office, some on the planning commission staff, some in the welfare department. Officials of cities without such an employee should try to establish a research position. Besides working on short range forecasts, a city analyst would be of incalculable value in performing tax analysis, helping industrial development programs, and doing many similar tasks. He would be the logical choice to serve as secretary to the research committee recommended in the preceding paragraph. There he could integrate the efforts of the committee and be responsible for setting forth the analysis of the trend data developed by the group.

Note: This report grew out of suggestions made by several city managers in the summer of 1950 who said they needed to know more about the availability and use of the kinds of information discussed in this report in order better to solve municipal problems. Accordingly the International City Managers' Association requested two specialists to prepare a short statement on this subject for use as an article in the December 1950 issue of Public Management. The same authors were invited to prepare for this MIS report a more detailed statement on the same subject with more emphasis on the sources of useful data and on the techniques of forecasting. Grateful acknowledgement is made to the authors of this MIS report: Victor Roterus, Assistant Chief of the Area Development Division, Bureau of Foreign and Domestic Commerce, United States Department of Commerce, and Robert C. Schmitt, Associate Planner, City Planning Commission, Seattle, Washington. The comments and suggestions of city managers and other municipal officials on the content of this MIS report are welcomed by the International City Managers' Association.



